CA2ALID20
67 C57

CA2 ALID 20 1967C57
Consumption of Silica Sand in Alberta.
1
3 3398 00137 4494

ALBERTA PROVINCIAL LIBRARY
JAN 1974
EDMONTON

PROVINCE OF ALBERTA

CANADA

THE CONSUMPTION OF SILICA SAND IN ALBERTA

LIBRARY
VAULT 19

ALBERTA BUREAU OF STATISTICS
DEPARTMENT OF INDUSTRY AND DEVELOPMENT

REPORT

ON THE CONSUMPTION

OF

SILICA SAND

IN

ALBERTA

Alberta Bureau of Statistics,
Department of Industry and Development,
EDMONTON, Alberta.

March - 1967

SILICA SAND

INTRODUCTION:

The term "silica sand" as opposed to "ordinary sand" implies a sand whose chemical composition is primarily quartz with very few other impurities. Therefore, the terms "silica sand" and "quartz sand" are synonymous. Typically, the composition of most commercial silica sand is high in silica and low in iron.

Silica sand is used in the manufacture of glass and glass fibre, by foundries for moulding purposes, in some asphalt roofing products, and for high quality sandblasting. Special grades of high quality silica sand are also used by oil servicing companies in the hydraulic fracturing of oil formations.

LOCATION OF KNOWN DEPOSITS:

A number of deposits of high grade silica sand have been discovered in Alberta. However, very few of the deposits are ideally situated with respect to transportation and often the distance to markets makes their development uneconomic at the present.

a) Peace River Deposit (1)
Seven miles north of the town of Peace River is an unconsolidated, clean, fine-to-coarse grained quartz sand, located in the upper 40 - 60 feet of Peace River formation (Lower Cretaceous).

b) Pipestone River (1)
This deposit, located approximately 22 miles north of the Lake Louise Station, lies within the National Park boundary

and therefore, cannot be commercially exploited.

c) McMurray (2)

Sand obtained from the oil sands in the McMurray formation consists essentially of quartz with mica as the chief impurity. Based on the analysis of samples taken near Bitumont and McMurray, it is felt that even after benefication, the final product would be too fine-grained for glass manufacture.

However, one authority[3] suggests that there are probably areas along the Athabasca River where sand of larger grain size and of the desired quality for glass manufacturing exists.

It is further suggested that if the hot water method of processing the oil sands is adopted, a clean high quality sand of commercial grade should be a by-product.

d) Bruderheim

North West Silica Sand Ltd. from its pit near Fort Saskatchewan produces a silica sand used in the manufacture of glass fibre. This sand is also the main constituent in moulding sand used in several Edmonton foundries, but it must be processed before it is suitable for these industrial users.

SOURCE OF SUPPLY:

Generally the bulk of Alberta's requirements for industrial silica sand are imported. The largest portion of the imported sand comes from Ottawa, Illinois and LeSueur, Minnesota. Sand used in oil-well fracturing is imported from Brady, Texas.

SPECIFICATIONS OF SILICA SAND FOR INDUSTRIAL USERS:

The following specifications are those generally recommended by manufacturers and oil field fracturing companies.

a) Oil-Well Fracturing

The main requirements for silica sand for this purpose is that it is pure, round and hard. The grain size should be fairly uniform and fall in the 10 - 20 mesh range (see table 1).

b) Glass Manufacturing

The sand should be screened, sized and free from iron oxide to less than 0.03% (see tables 2, 3, 4, and 5 for further specifications).

c) Foundry Sands

Foundry sands must have a suitable grain size and shape. The sand grains must be able to withstand the high temperature of molten cast iron. Therefore, the constituents should all have a high fusion point. Also grains must be of large enough size and round enough to allow hot gases to escape through the sands.(4) (see table 6).

MANUFACTURING CONSUMPTION:

The consumption of high-grade silica, by manufacturing industries in Alberta, appears to be relatively stable since 1961. It is evident that the market for silica sand will be determined largely by the requirements of these industrial users.

OIL FIELD CONSUMPTION:

Silica sand is used by oil-well servicing companies, primarily in the fracturing of sandstone formation. In 1961, the consumption of

silica was estimated by users and suppliers at 15,000 tons (see table 10). By 1966, an estimated 3,800 tons of sand were used in Alberta for fracturing purposes. The sharp decrease in consumption occurred due to:

1) Low level of exploration drilling in sandstone formations,
2) Other products, such as glass beads and aluminum pellets, were used as substitutes for silica sand.

CONCLUSION:

A producer wishing to supply the local silica sand market will have to meet the specifications of those industries using the product. Currently in Alberta, the glass industry is the major user and its requirements are the most exacting.

LIST OF TABLES

Table No.

1. Specifications of Silica Sand Used in Oil-Well Fracturing.

2. Specifications for Chemical Composition of Glass Sands.

3. Chemical Analysis of Glass Sand from Ottawa, Illinois.

4. Grading of Glass Sand.

5. Cumulative Screen Analysis of Glass Sand.

6. Percent Limits of Composition for Foundry Sands.

7. Foreign Imports of Silica Sand Cleared at Customs' Ports, Alberta, Saskatchewan, and Manitoba, 1958-1964.

8. Industrial Sand Carried by Railways, Alberta, Saskatchewan and Manitoba, 1958-1965.

9. High-Grade Silica Sand Used in Manufacturing Industries, Alberta, 1958-1965.

10. Estimate of Imported Silica Sand Used in Oil-Field Fracturing Operations, Alberta, 1961, 1964-1966.

11. Freight Rates for Imported Silica Sand (carload lots) 1967.

Map: Distribution of Silica Sand in Alberta.

TABLE 1

SPECIFICATIONS* OF SILICA SAND USED IN OIL - WELL FRACTURING

	SPECIFICATION
Grain Size	desire 10 - 20 mesh, 80% of all particles must fall in desired mesh range.
Roundness Factor	must be greater than 0.7 krumbein (measure of roundness) ideal 1.0 krumbein.
Strength	greater than 25 pounds per particle, prefer greater than 200 pounds per particle.
Specific Gravity	less than 2.7
Other	should not react with HCl, should not be oil soluble, not more than 1% silt or foreign material.

---

* These are the specifications required by the Pan American Petroleum Corporation. It is possible that other oil producers may have slightly different specifications; nevertheless, these same general standards exist throughout the petroleum industry.

TABLE 2

SPECIFICATIONS FOR CHEMICAL COMPOSITION OF GLASS SANDS*(5)

Qualities	SiO_2 Minimum %	Al_2O_3 Maximum %	Fe_2O_3 Maximum %	CAO + M_gO Maximum %
First quality, optical glass	99.8	0.1	0.020	0.1
Second quality, flint-glass containers and tableware	98.5	0.5	0.035	0.2
Third quality, flintglass	95.0	4.0	0.035	0.5
Fourth quality, sheet glass, rolled and polished plate	98.5	0.5	0.060	0.5
Fifth quality, sheet glass, rolled and polished plate	95.0	4.0	0.060	0.5
Sixth quality, green glass containers and window glass	98.0	0.5	0.300	0.5
Seventh quality, green glass	95.0	4.0	0.300	0.5
Eighth quality, amber containers	98.0	0.5	1.000	0.5
Ninth quality, amber	95.0	4.0	1.000	0.5

---

* Recommended by American Ceramic Society and National Bureau of Standards.

TABLE 3

CHEMICAL ANALYSIS OF GLASS SAND* AT OTTAWA, ILLINOIS (5)

Source	Composition	Percent				
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Ignition
	%	%	%	%	%	
Ottawa, Illinois	99.607	0.160	0.021	0.050	0.03	0.08

* From Weigel (6)

TABLE 4

GRADING OF GLASS SAND * (5)

Passing Sieve mesh size	Percentage of Grains Retained %
No. 40	40 - 60
No. 60	30 - 40
No. 100	10 - 20
Less than No. 100	0 - 5

* Recommended by American Ceramic Society and the National Bureau of Standards.

TABLE 5

CUMULATIVE SCREEN ANALYSIS OF GLASS SAND FROM OTTAWA, ILLINOIS(5)

Sand Retained on mesh size	Sample No. 1 Cumulative %	Sample No. 2 Cumulative %
20	0.00	0.00
28	0.10	3.40
35	19.50	30.50
48	60.00	65.00
65	85.70	82.10
100	98.00	92.90
150	99.80	98.20

Note: Mesh size is the number of openings per linear inch.

TABLE 6

PERCENT LIMITS OF COMPOSITION FOR FOUNDRY SANDS (4)

COMPONENT	CAST IRON melting point (M.P.) 2400 - 2700°F	STEEL melting point (M.P.) 2700 - 2800°F.
Quartz M.P. 3110°F (Silica SiO_2)	Fairly high perhaps 80%	Perhaps 90%, as high as possible.
Feldspar (M.P. 2192 - 2372°F)	20% maximum	with 20% "burning on occurs"
Iron Oxide Fe_2O_3	perhaps 3 - 10% max.	perhaps 2 - 7% max. small amounts, max.
Mica	-	small amounts, max.
Alkalies Na_2O	trace, max.	trace, max.
Free Lime CaO, Mgo	trace, max.	trace, max.
Clay substances	15 - 25% % max.	perhaps 10 - 20% max.

TABLE 7

FOREIGN IMPORTS OF SILICA SAND CLEARED AT CUSTOMS' PORTS ALBERTA, SASKATCHEWAN AND MANITOBA, 1958-1964

YEAR	QUANTITY	VALUE
	tons	$
1958		
Alberta	38,867	170,997
Saskatchewan	1,487	8,615
Manitoba	6,858	35,224
1959		
Alberta	53,969	197,929
Saskatchewan	3,208	21,762
Manitoba	12,925	59,775
1960		
Alberta	57,029	218,759
Saskatchewan	4,188	27,099
Manitoba	12,813	58,810
1961		
Alberta	50,492	181,784
Saskatchewan	n/a	n/a
Manitoba	11,853	51,145
1962		
Alberta	54,000	216,639
Saskatchewan	5,200	39,337
Manitoba	11,600	51,718
1963		
Alberta	47,447	231,928
Saskatchewan	4,745	44,347
Manitoba	4,943	31,503
1964		
Alberta	22,973	111,634
Saskatchewan	4,658	43,800
Manitoba	4,728	34,695

TABLE 8

INDUSTRIAL SAND* CARRIED BY RAILWAYS, ALBERTA, SASKATCHEWAN AND MANITOBA, 1958 - 1965

ALBERTA

Year	Originated or Loaded At Stations in Alberta	Received from U.S. (Rail) Destined to Canadian Points	Terminated or Unloaded at Stations in Alberta
	tons	tons	tons
1958	432	662	48,136
1959	454	64	57,323
1960	2,051	1,119	55,090
1961	11,473	162	57,588
1962	1,123	2,811	47,614
1963	142	-	50,162
1964	3,439	378	51,059
1965	7,575	-	49,921

SASKATCHEWAN

Year	Originated or Loaded At Stations in Saskatchewan	Received from U.S. (Rail) Destined to Canadian Points	Terminated or Unloaded at Stations in Saskatchewan
	tons	tons	tons
1958	28	30,045	1,927
1959	45	44,004	21,858
1960	2,337	22,648	3,748
1961	227	43,383	5,841
1962	75	40,284	4,551
1963	150	32,172	4,997
1964	289	22,515	6,683
1965	93	13,926	3,741

MANITOBA

Year	Originated or Loaded At Stations in Manitoba	Received from U.S. (Rail) Destined to Canadian Points	Terminated or Unloaded at Stations in Manitoba
	tons	tons	tons
1958	19,464	12,046	17,277
1959	3,142	19,357	13,931
1960	1,217	16,906	12,727
1961	40	16,337	12,339
1962	507	15,635	13,300
1963	2,447	9,357	6,361
1964	41,240	7,282	12,381
1965	50,062	10,368	21,342

(*) Industrial Sand includes:

Blast Sand
Bonded Sand
Core Sand (NOIBN)
Filtering Sand
Fire Sand
Foundry Sand
Furnace Sand
Glass Sand
Grinding Sand
Ground Sand
Ground Silica
Loam Sand
Molding Sand
Polishing Sand
Pulverizing Sand
Silica Sand

TABLE 9

HIGH QUALITY SILICA SAND USED IN MANUFACTURING INDUSTRIES *
ALBERTA, 1958 - 1965

Year	Quantity tons	Value $
1958	31,503	419,995
1959	38,014	487,616
1960	36,644	497,033
1961	39,962	536,767
1962	42,888	585,089
1963	42,359	583,200
1964	46,397	579,535
1965	42,449	507,930

* Chemcell Limited - Duvernay

Dominion Glass Co. Ltd., - Redcliff

Fiberglas Canada Ltd., - Edmonton

Irving Industries (Div. of Foothills Steel Foundry) Ltd., - Calgary

Peace River Glass Company Ltd., - Ft. Saskatchewan

Quality Steel Company Ltd., - Edmonton

TABLE 10

ESTIMATED QUANTITY (BY USERS AND SUPPLIERS) OF IMPORTED SILICA SAND USED IN OIL-WELL FRACTURING OPERATIONS, 1961, 1964 - 1966

Year	Quantity tons
1961	15,000
1964	3,000
1965	4,500
1966	3,800
1967	6,[illegible]
1968	5,660

Used by: Eskimo Fracturing and Well Servicing Ltd., Edmonton

Dowell of Canada Ltd., Edmonton

Halliburton Oil Well Cementing Co. Ltd., Edmonton

Supplied by: Cardium Supply Ltd., Edmonton

TABLE 11

FREIGHT RATES FOR IMPORTED SILICA SAND (CARLOAD LOTS) 1967

FROM	TO EDMONTON per ton	CALGARY per ton	MEDICINE HAT per ton
Ottawa, Illinois	$12.75 open car $13.86 closed car	$12.75 open car $13.86 closed car	$11.61 open car $12.56 closed car
Le Suerue, Minn.	$12.75 open car $12.43 closed car	$12.75 open car $12.43 closed car	$11.61 open car $12.43 closed car
Brody, Texas	$17.89	$18.60	$16.47
Selkirk, Man.	$ 8.80	$ 8.60	$ 7.60
Waterways, Alta.	$ 4.00 - $ 8.00* (minimum 35 tons)	$ 9.80*	$13.80*

* Rate subject to negotiation with N. A. R.

Source: Alberta Freight Bureau.

BIBLIOGRAPHY

1. Govett, G.J.S. and Byrne, R.J.S.
Industrial Minerals of Alberta
Preliminary Report 58 - 2, Geological Division,
Research Council of Alberta,
Edmonton.

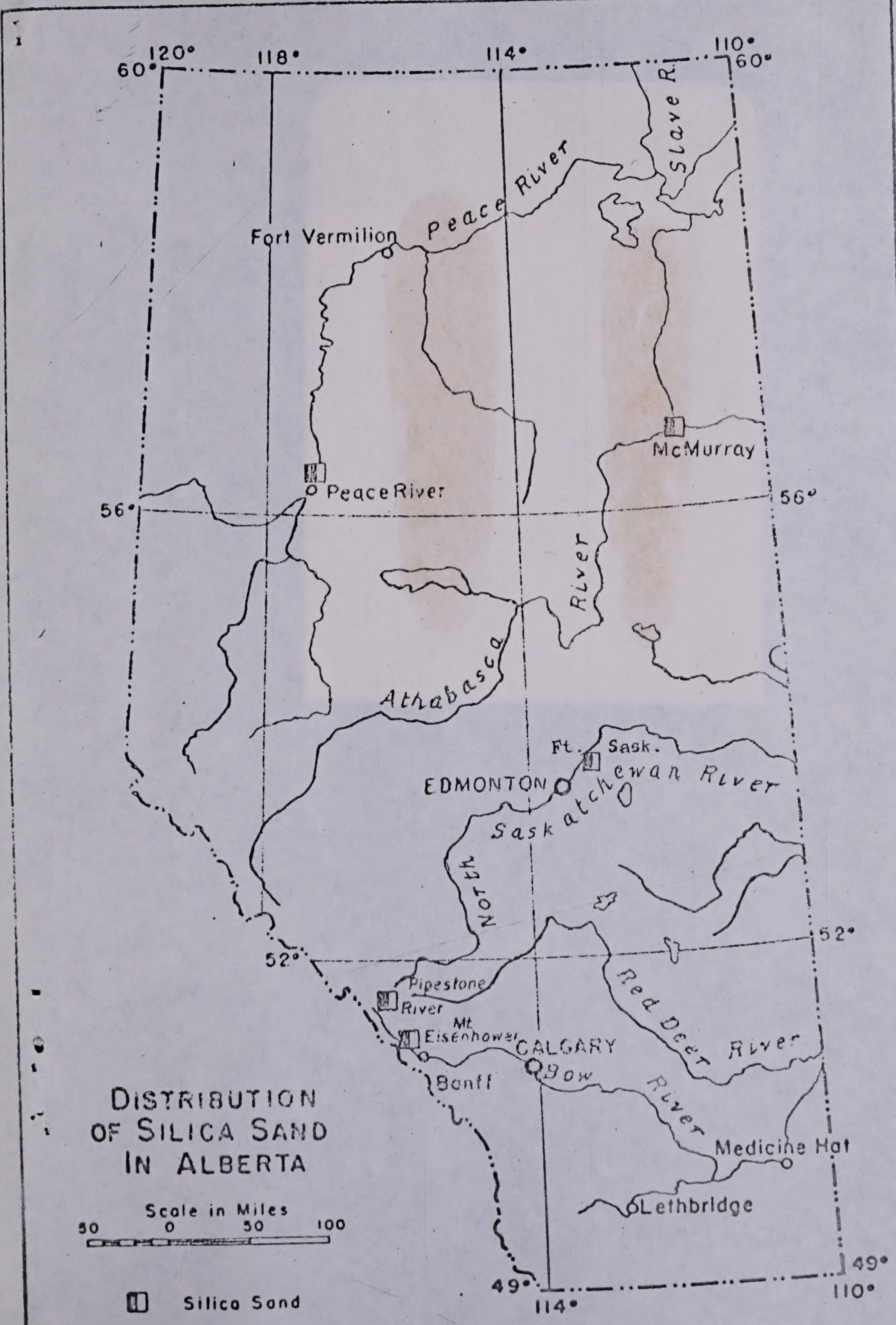
2. Ibid.

3. Carrigy, M.A. Geologist,
Research Council of Alberta
Edmonton.

4. Fitzpatrick, Arthur,
Properties of Foundry Sands,
Research Council of Alberta,
Edmonton.

5. Industrial Minerals and Rocks
American Institute of Mining and Metallurigical Engineers, 1949,
Seeley W. Mudd Series.

6. Weigel, W.M.
Technology and Uses of Silica and Sand
U.S. Bur, Mines Bulletin 266 (1927).



DISTRIBUTION OF SILICA SAND IN ALBERTA

ALBERTA

LEGISLATURE LIBRARY
216 LE SLATURE BUILDING
EDM BERTA

DATE